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CASE REPORT

All-in-one-piece type prosthesis combining an obturator, a facial prosthesis, and glasses for the rehabilitation of midfacial defect and its speech evaluation: A clinical report

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ABSTRACT

This case report describes the use of an all-in-one-type prosthesis that combines an obturator, a facial prosthesis, and glasses in a 70-year-old man with a mid-facial defect caused by oral squamous cell carcinoma. The patient had undergone maxillary resection and postoperative recovery with an obturator; however, slurred speech, water leakage from the nose, and aesthetic issues persisted. The all-in-one-type prosthesis was designed to improve speech and aesthetics by connecting the obturator and facial prosthesis with a magnet and connecting the epithese to the glasses. The prosthesis was fabricated by a dental technician, who created a wax pattern of the epithese directly on the patient's face and used it to fabricate a custom-made epithelial prototype. The final prosthesis was fitted and adjusted for optimal position and comfort. The improvement in speech function was evaluated via formant analysis and nasalance evaluation and found to be satisfactory. *(Int J Maxillofac Prosthetics 2023;6:20-24)*

Keywords

Obturator, facial prosthesis, formant analysis, nasalance, oral squamous cell carcinoma.

AUDIOABSTRACT

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INTRODUCTION

The midface, comprising the palate, cheek, maxilla, upper lip, orbit, and nose, is the most important part of the face and has several important functions. The maxilla is a bony structure bound by the skull base on the upper surface and the occlusal plane on the lower surface, separating the oral and nasal cavities. The maxilla is the origin of several facial mimetic muscles, which enable resisting the forces of mastication, forming negative pressure in the mouth for swallowing, and maintaining clear speech. Moreover, the facial mimetic muscles provide a facial appearance that is unique to the individual. Thus, midfacial surgical defects impair the orofacial function, aesthetics, and psychological well-being of patients.[1] A return to a good quality of life is crucial when one or more of the dysfunctions result from midfacial defects caused by tumor resection, trauma, congenital anomalies, inflammatory or degenerative diseases; this can be achieved via reconstruction or the use of prostheses. Futan et al.[2] suggested that the “ideal reconstruction of maxillary defects requires, in order of importance, the presence of a healed wound; separation of oral and nasal cavities; restoration of maxillary buttresses; restoration of functional dentition, mastication, and deglutition; re-establishment of globe position or addressing an exenterated cavity cosmetically; maintenance of a patent nasal airway; support and

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suspension of adynamic facial soft tissue, including avoidance of ectropion; and restoration of the midfacial contour."

Owing to their complex anatomy, midfacial defects can have several shapes and sizes; therefore, many patients with such defects use prostheses that are tailored to the form of the defect for rehabilitation purposes. However, depending on the size and location of the defect, maintaining the prosthesis may be problematic. Methods of auxiliary retention include the use of magnets,[3,4] adhesives, rubber bands,[5] combinations of these,[6] and implants.[7]

This case report describes the use of an all-in-one-type prosthesis that combined an obturator, a facial prosthesis, and glasses for a patient with a midfacial defect and the evaluation of speech function and its improvement with the use of this prosthesis.

CASE REPORT

Patient characteristics and treatment history

A 70-year-old man diagnosed with oral squamous cell carcinoma (cT4aN2cM0) received preoperative concurrent chemoradiotherapy (Σ40 Gy) 20 days + TS-1 100 mg/day in September 2016. Left subtotal maxillary resection, bilateral cervical dissection, and rectus abdominis reconstruction were performed in October 2016. Right subtotal maxillary resection and segmental skin grafting were performed in December 2016. Partial maxillary resection with a lateral nasal incision was performed in February 2017. He was referred to the Clinic of Maxillofacial Prosthetics, Tokyo Medical and Dental University, to undergo a preoperative examination for post-surgical prosthetic rehabilitation. The nasal and oral cavities were connected postoperatively, and a surgical obturator was used to facilitate postoperative healing and improvement of speech and masticatory function via frequent adjustments (Fig 1A). The patient received an obturator

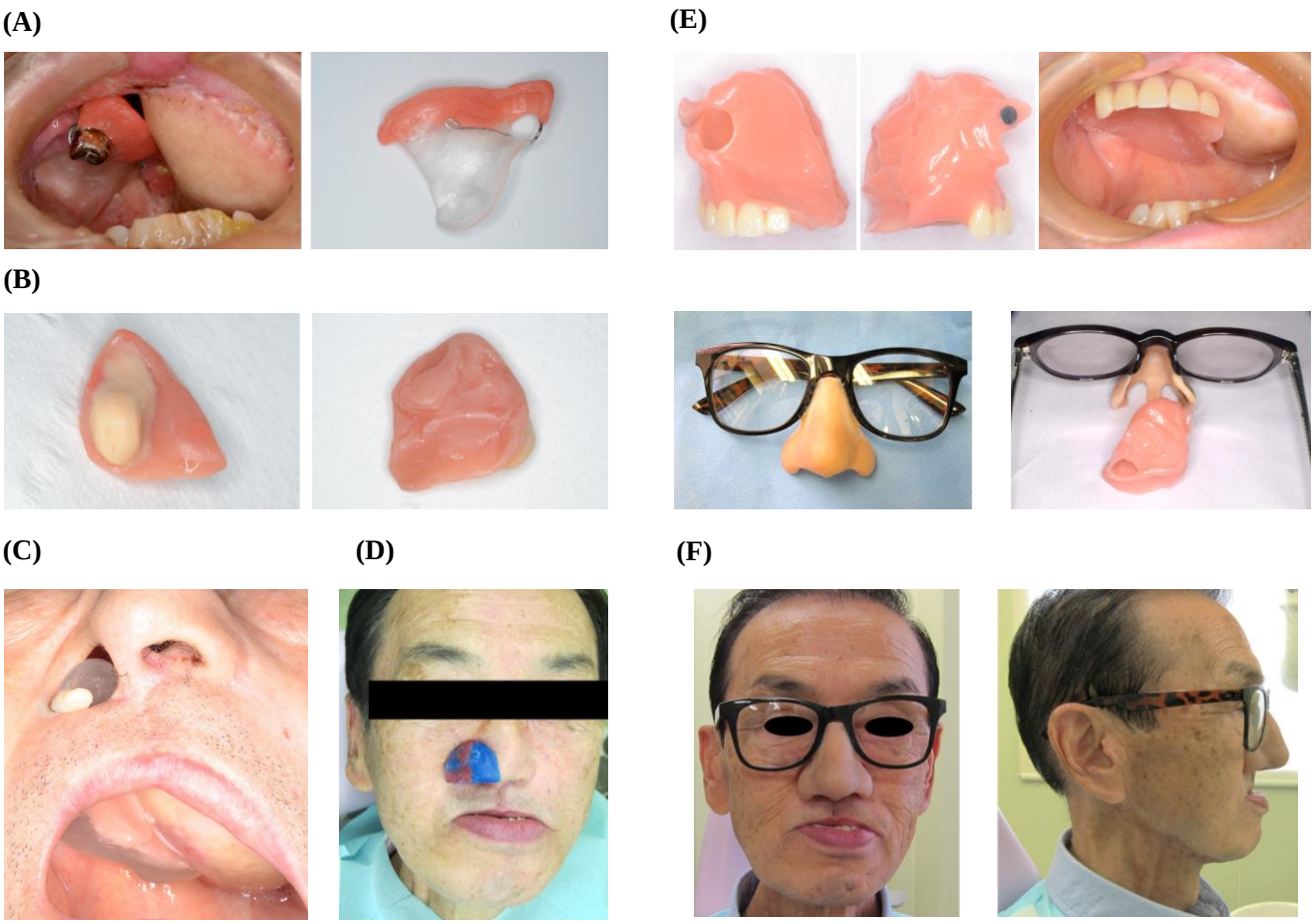

Fig 1. Treatment history and fabrication of the all-in-one-type prosthesis. (A) A surgical obturator, postoperatively. (B) First obturator. (C) Retention is improved by adding methyl methacrylate resin on the nasal side of the obturator. (D) A wax pattern of the epithese is fabricated directly on the patient's face. (E) The all-in-one-type prosthesis combining an obturator, epithese, and glasses. (F) Facial view of the patient wearing the prosthesis.

in March 2018 following postoperative recovery (Fig. 1B). Postoperative and ongoing prosthetic treatment resulted in the functional recovery of mastication; however, unclear speech, water leakage from the nose, and esthetic issues persisted. Additional reconstructive procedures at the perforation site were recommended to resolve these issues. However, the patient preferred non-invasive treatment with maxillofacial prosthetics. Therefore, we fabricated an all-in-one-type prosthesis for the patient that combined an obturator, a facial prosthesis, and glasses.

Fabrication of the all-in-one-type prosthesis

A duplicate of the previously used obturator was created, and its stability was evaluated. The retentive force was improved by adding methyl methacrylate resin on the nasal side of the obturator in an occlusal, mechanically stable position with the remaining mandibular teeth (Fig. 1C). This device was used as the main obturator after stabilization, and the fabrication of the facial prosthesis was commenced. In an attempt to improve stability, the obturator and facial prosthesis were designed to be connected by a magnet positioned at the external nostrils. Furthermore, the design sought to improve the aesthetics and stability of the three devices by connecting the epithese to the glasses. A dental technician fabricated the epithese by creating a wax pattern for the epithese directly on the patient's face (Fig. 1D). A custom-made epithelial prototype was fabricated by making a pick-up impression, including the wax pattern and facial impressions. The search for the optimal position of the magnet with the obturator, adjustment of the nasal morphology, and correction of the positional relationship with the glasses was repeated by a dental technician in this prototype. After confirming the morphology and stable positioning of the three devices, pick-up impressions, including prototypes, were fabricated using a vinyl polysiloxane impression material (Exahiflex; GC, Tokyo, Japan). The nasal prosthesis was fabricated using the flask technique with an acrylic resin (Unifast, GC, Tokyo, Japan) and tested. Extrinsic colorations were applied to match the color of the peripheral skin. Figure 1(E) shows the completed prosthesis. Figure 1(F) shows the facial view of the patient wearing the all-in-one-type prosthesis combining the obturator, facial prosthesis, and glasses.

Evaluation of speech

Formant analysis, a digital speech analysis, and nasalance evaluation were performed before and after the fabrication of the prosthesis to evaluate the speech. The evaluation was conducted under three conditions: no device, obturator only, and with the all-in-one-type prosthesis. Formant analysis was performed based on a previous study by Sumita et al.,[8] and the evaluation of nasalance was performed based on a selection study by Liu et al.[9] The evaluation of nasalance has been used to assess function after maxillectomy in previous studies.[10]

Formant analysis was performed using a speech analysis system (CSL 4400, KayPENTAX, New Jersey, USA) with a high-quality dynamic microphone positioned at a constant distance of 20 cm from the patient's lips. Five Japanese vowels, namely, /a/, /e/, /i/, /o/, and /u/, were recorded. A 1-s segment was extracted from the amplitude-by-time waveform on the computer monitor. Linear predictive coding was used to reveal the formant data for each vowel, and the frequencies of the first to second formant (F1 F2) were extracted for each vowel.

Nasalance was measured using a nasometer (Nasometer Model 6400 KayPENTAX; New Jersey, USA). The headset was banded to the patient's head after calibrating the nasometer, and the metal separation under the patient's nose was adjusted to be parallel to the occlusal plane. The patient was instructed to utter monosyllables and sentences consisting of non-nasal sounds representing different intraoral pressures. All recordings were repeated three times. The software automatically calculated the nasalance as a percentage of the acoustic energy: nasal/total (nasal + oral). The highest and mean nasalance scores were recorded for each test sentence, and the average value of three repeated measurements was calculated.

Outcome

The all-in-one-type prosthesis was held in a stable position with no displacement during the opening and closing of the mouth and daily use as the connection between the three parts stabilized the device. The patient was able to place and remove the all-in-one-type prosthesis.

Figure 2 shows the formant analysis, where the x- and y-axes indicate F1 and F2, respectively. The F1 and F2 ranges for the five vowels were larger with the all-in-one-type prosthesis than those without it or with only obturators.

Figure 3 shows the highest and mean nasalance results. The nasalance values improved when the device was fitted. Moreover, the patient's speech improved with the use of the all-in-one-type prosthesis.

The patient and his family were satisfied with the esthetic outcome, and the all-in-one-type prosthesis prevented water leakage from the nose.

DISCUSSION

The parts of the prostheses, which were less stable individually, were linked together and combined into a single mass in the present case, resulting in the rigidity of the devices in daily use, thereby improving speech, nasal leakage, and esthetic outcomes. The structure and function following maxillectomy can be restored through two options: surgical reconstruction of the defect and prosthetic rehabilitation. Both treatment options are beneficial for patients. A previous study reported no differences between the results of surgical reconstruction and those of prosthodontic intervention for maxillary defects when the facial attractiveness was assessed by naive raters and the speech outcomes were assessed using objective measurements.[11] A systematic review by Cao et al. concluded that the use of obturators and surgical reconstruction might be effective in rehabilitating functions after maxillary ablation.[12] Santos et al. proposed that the treatment of the maxilla must be based on the individual characteristics of each patient.[13]

In the present case, the patient had a history of radiotherapy, and the risk of bone reconstruction was high; therefore, surgical reconstruction was not selected. The effect of the improved stability of the device on speech was evaluated using formants and nasalance, and the improvement in the test values with the device was confirmed. Although the assessment of speech in patients with midface defects has been reported in recent years,[14] these tests have not been systematically reflected in treatment decisions as the selection of test tones and reference values for judging the speech in patients with midfacial defects has not been established definitively. The validity of the reference values for the evaluation of velopharyngeal insufficiency in patients with cleft lip and palate has been examined,[15] and a similar examination of the reference values for the evaluation of speech in patients with midfacial defects is required. In this context, this report has the novelty of demonstrating the possibility of assessing speech as a treatment outcome for patients with midfacial defects and emphasizing the further need for speech assessment.

CONCLUSSION

In cases where surgical reconstruction of the midface may not be possible for various reasons, maxillofacial prosthetics can make a significant contribution to the patient's postoperative quality of life. However, since each defect is unique, customized treatment, depending on the size and location of the lesion, must be performed on an individual basis. Moreover, it is important to collaborate with dental technicians who perform prosthesis fabrication. In the present case, achieving the ideal nasal morphology for the patient and the natural connection between the glasses and the epithese were major hurdles during treatment, though the dental technicians communicated directly with the patient at the chair side as a member of the team while fabricating the prosthesis. Therefore, the technician was able to understand the patient's detailed requests and consideration points and reflect them in the device, which was a major factor in the success of this case. Maxillofacial prosthodontists must take the initiative and play a central role in bridging the relationship between oral and plastic surgeons and dental technicians.

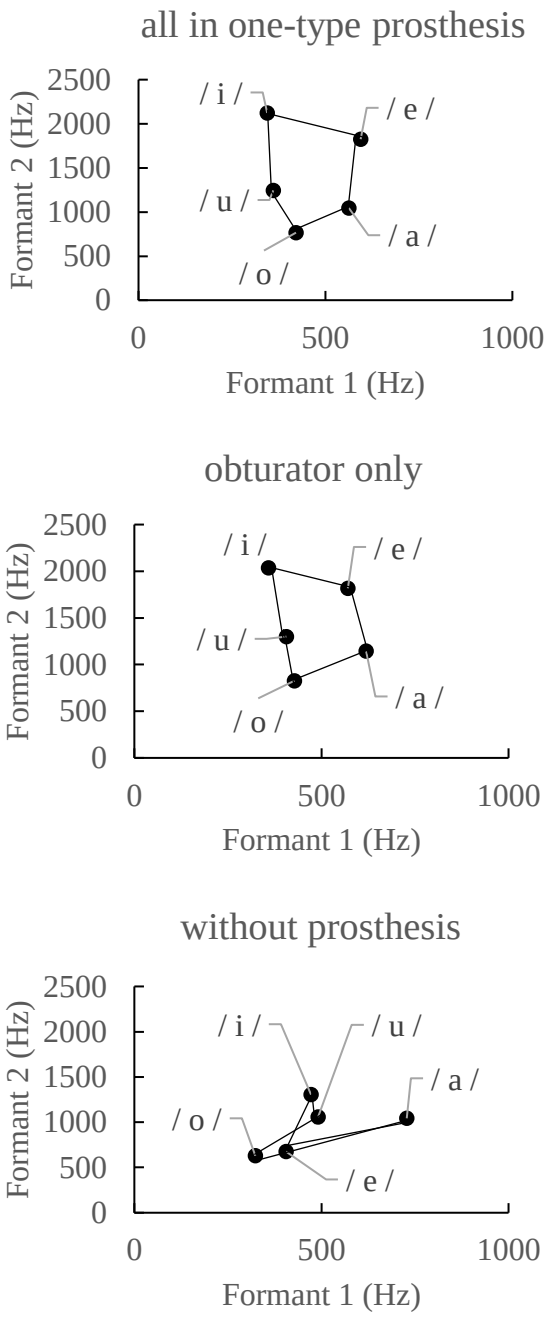

Fig 2. Results of the formant analysis of five vowels.

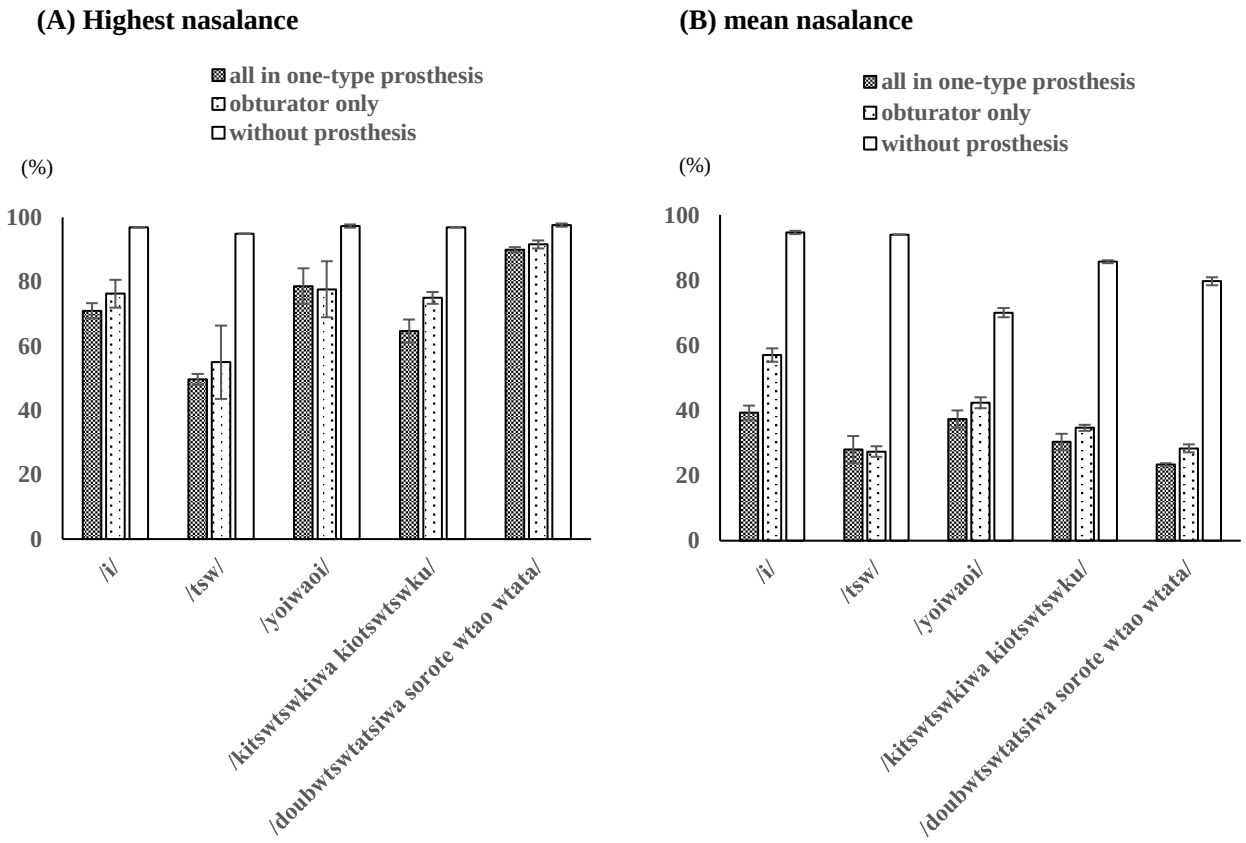

Fig 3. Results of the highest and mean nasalence.

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